PATENT SPECIFICATION

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Improvements in Actuators for Elements such as Valves

We, JONES, TATE & CO. LIMITED, a British Company, of 165 Great Dover Street, London, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to actuators for elements such as valves, an object of the invention being the provision of an improved form of actuator which may be operated by hand or by power as desired.

In an actuator for an element, such as a valve, operable alternatively manually or by a motor, according to the present invention clutch means include a driving portion and a driven portion movable, by a centrifugal device arranged to be driven by a motor, from a position to which the portion is biassed and in which a manually operable drive is connected through the clutch means with an output member driving the element to a position in which a motor operable drive is connected through the clutch means with the output member.

The invention will now be described, by way of example, with reference to the accompanying, partly diagrammatic, drawings, in which :—

Figure 1 is a sectional elevation through various shafts of a valve actuating mechanism ;

Figure 2 is an enlarged sectional plan view taken on the line II-II of Figure 1 ;

Figure 3 is a sectional elevation of an alternative form of part of the actuating mechanism ;

Figure 4 is a sectional elevation of a further alternative form of a part of the actuating mechanism ;

Figure 5 is a sectional plan view taken on the line V-V of Figure 4 ;

Figure 6 is a sectional elevation of a further alternative arrangement of a part of the actuating mechanism ; and

Figure 7 is a sectional plan view taken on the line VII-VII of Figure 6.

Referring to Figure 1 of the drawings, the actuating mechanism is enclosed in a casing 1, the output being delivered to a threaded valve spindle 2 arranged for axial movement. The threaded valve spindle 2 seats within a correspondingly threaded bush 3 positioned within a hollow sleeve 4 by a key 5 and held against an annular shoulder 6 by a circlip 7 and thrust washer 8. The upper end 9 of the sleeve 4 is of reduced external diameter and is mounted in a bearing 10 in the casing 1, whilst the lower end 11 of the sleeve 4 is of increased external diameter and is mounted in a ball thrust bearing 12, an assembly 12A of packs of spring washers spaced around the upper ring of the bearing being provided to absorb sudden axial impulses in either direction. The sleeve 4 is restrained from axial movement by a circlip 13 abutting a hub 14 of a spur wheel 15, the hub 14 in turn being supported on an outer sleeve 16 abutting the assembly 12A which is positioned on the ball thrust bearing 12 mounted on an annular shoulder 17 formed in the casing 1. Upward axial movement of the sleeve 4 is restrained by a restraining ring 17A secured to the casing 1 and abutting a part of the upper surface of the assembly 12A, any upward load being transmitted from an annular shoulder 17B formed on the sleeve 4 through the ball thrust bearing 12 to the assembly 12A.

The spur wheel 15 is keyed to the sleeve 4 and is driven by a pinion wheel 18 keyed to a drive shaft 19. The shaft 19 is formed with upper and lower ends 20, 21 of reduced diameter and is mounted in upper and lower step bearings 22, 23 in the casing 1.

The drive is transmitted to the shaft 19

through a dished gear wheel 24 freely mounted on the shaft 19 and provided with three, equiangularly spaced pawls 25, one of which is shown in Figure 1, each having a frusto-conical head 26 arranged to engage a corresponding ball 27 carried in a cylindrical aperture 28 in a flanged disc 29 keyed to the shaft 19 and resting on an annular shoulder 30 formed on the shaft. The balls 27 are biassed upwardly and held in contact with the frusto-conical heads 26 of the pawls 25 by a retaining plate 31 and a calibrated spring 32 extending between the retaining plate 31 and a collar 33 threaded onto the lower end 21 of the shaft 19. Upward movement of the flanged disc 29, the dished gear wheel 24 and the pinion wheel 18 is restrained by a circlip 34 extending around the upper end 20 of the shaft 19. Upon the dished gear wheel 24 being driven, the frusto-conical heads 26 of the pawls 25 tend to depress and ride over the balls 27. Since the calibrated spring 32 opposes downward movement of the balls 27 and retaining plate 31, such downward movement is proportional to the torque transmitted from the pawls 25 to the balls 27 and may be utilised to operate a torque limit switch (not shown) arranged to de-energise an electric motor driving, in a manner described below, the dished gear wheel 24 when a predetermined value of torque occurs in the drive. In addition, should the torque limit switch not be effective to interrupt the drive, the stiffness of the calibrated spring is such that the pawls 25 may force the balls 27 downwardly to such an extent as to be able to ride over them, and thereby provide slip in the drive, should the valve spindle 2 meet an impediment in its travel causing an objectionable value of torque to be set up. In such circumstances, on riding over the pawls 25, the balls 27 impact on the dished gear wheel 24 and succeeding pawls 25 under the influence of the calibrated spring 32, so that audible warning of the objectionable value of torque is given. It will be understood that such an arrangement is also advantageous in circumstances when the dished gear wheel 24 is manually driven, in a manner as is described below.

The dished gear wheel 24 meshes with a first or dished pinion wheel 35 splined to a hollow shaft 36 formed with upper and lower axially extending slots 37, 38 and splines 39. The drive from the hollow shaft 36 to the shaft 19 is speed decreasing since the dished pinion wheel 35 is of smaller diameter than the dished gear wheel 24. The hollow shaft 36 is formed with upper and lower ends at 40, 41 of reduced diameter and is mounted in upper and lower step bearings 42, 43 in the casing 1, upper and lower wheel bearings 44, 45 extending intermediate respective step bearings 42, 43 and upper and lower shoulders 46, 47 formed on the hollow shaft 36. The splines 39 extend intermediate the upper and lower shoulders 46, 47. The dished pinion wheel 35 is splined to the hollow shaft 36 and is axially retained in position on the hollow shaft by means of a lower circlip 48 and an upper circlip 49 together with a thrust washer 50. A clutch shaft 51 extends within the hollow shaft 36 and is provided with upper and lower pins 52, 53 respectively extending through the upper and lower slots 37, 38 in the hollow shaft. A spring 54 extending between an internal circlip 55 positioned within the upper end 40 of the hollow shaft 36, and a shoulder 56 formed above the upper pin 52 on a clutch shaft 51, biasses the clutch shaft in a downward direction. The lower pin 53 carries a lower dog clutch 56 splined to the hollow shaft 36 and formed with dogs 57 and is biassed by the spring 54 into engagement downwardly so that the dogs 57 engage dogs 58 formed on the hub 59 of a second or hand operated bevel wheel 60 freely rotatable on the hollow shaft 36. The hand operated bevel wheel 60 is driven by a bevel wheel 61 mounted on a hand wheel shaft 62 extending through the casing 1 and provided with a hand wheel 63.

Freely mounted on the hub 64 of the dished pinion wheel 35 is a third or clutch pinion wheel 65 meshing with a clutch spur wheel 66 mounted on a motor extension shaft 67 connected with an output shaft 68 of an electric motor (not shown). The electric motor is reversible and is controlled by suitable means including limit switches. The motor extension shaft 67 is mounted in suitable upper and lower bearings 69, 70 in the casing 1. The gearing is speed increasing from the motor extension shaft 67 to the clutch pinion wheel 65. The clutch pinion wheel 65 is provided with two, diametrically opposed lugs 71 each of which supports a saddle 72 by means of a pin 73 extending through the lug 71 and saddle 72. Each saddle 72 carries a cylindrical weight 74 secured to the saddle by a recessed head screw 75 and is formed with an arm 76 (as shown in Figure 2) provided with a roller cam follower 77. The ends 78 of the cylindrical weight 74 are of reduced diameter and brackets 79 are rotatably mounted thereon, adjacent brackets on the respective cylindrical weights 74 being loosely connected together by a bolt 80 threaded into a first bracket and secured by a locking nut 81 and extending freely through a second bracket, the head 82 of the bolt being spaced from the second bracket, thereby forming a restricted yoke 83. The roller cam followers 77 are arranged to engage the lower surface 84 of an upper dog clutch 85, formed with dogs 86, splined to the hollow shaft 36 and mounted on the upper pin 52 of the clutch

shaft 51. Dogs 87 are provided on the hub 88 of a fourth or motor spur wheel 89 which is freely mounted on the hollow shaft 36 and meshes with a motor pinion wheel 90 keyed to the motor extension shaft 67. The drive from the motor extension shaft 67 through the motor pinion wheel 90 to the motor spur wheel 89 is speed decreasing since the motor pinion wheel 90 is of smaller diameter than the motor spur wheel 89.

Upon energising the electric motor to rotate the motor extension shaft 67 in either direction, the clutch spur wheel 66 drives the clutch pinion wheel 65 so that the cylindrical weights 74 carried on the clutch pinion wheel 65 are rotated about the axis of clutch shaft 51 and moved in an outward direction due to the centrifugal force. Movement of the cylindrical weights 74 in an outward direction causes the roller cam followers 77 to move in an upward direction thereby moving the upper dog clutch 85 in an upward direction. Movement of the upper dog clutch 85 is transmitted through the upper pin 52, the clutch shaft 51 and the lower pin 53 to the lower dog clutch 56 to move the dogs 57, against the action of the spring 54, out of engagement with the dogs 58 on the hub 59. Further movement of the roller cam followers 77 in an upward direction causes the dogs 86 on the upper dog clutch 85 to engage the dogs 87 on the hub 88. Thus the drive from the electric motor is transmitted through the motor pinion wheel 90, the motor spur wheel 89, the upper dog clutch 85 and the hollow shaft 36 to the dished pinion wheel 35. The dished pinion wheel 35 in turn drives the gear wheel 24, the pinion wheel 18 and the spur wheel 15 to rotate the sleeve 4 and axially move the valve spindle 2. Since the clutch pinion wheel 65 is also rotated from the motor extension shaft 67, the cylindrical weights 74 remain an outwardly displaced position, and the dogs 86 in the upper dog clutch 85 are held in engagement with the dogs 87 on the hub. The restraining yoke 83 acts to prevent movement of the cylindrical weights 74 in an outward direction further than that necessary to hold the dogs 86 in engagement with the dogs 87.

Upon de-energising the electric motor the clutch pinion wheel 65 slows down and stops rotating so that the centrifugal force upon the cylindrical weights 74 is removed and the spring 54 acts to move the clutch shaft 51 in a downward direction to disengage the dogs 86 of the upper dog clutch 85 from the dogs 87 and, upon further downward movement to engage the dogs 57 on the lower dog clutch 56 with the dogs 58 on the hub 59 on the hand operated bevel wheel 60, the roller cam followers 77 being biassed by the spring 54 in a downward direction and the cylindrical weights 74 in an inward direction. It will be understood that since the dogs 57 on the lower dog clutch 56 engage the dogs 58, the drive is transmitted through the hand wheel 63, the bevel wheel 61, the hand operated bevel wheel 60, the lower dog clutch and the hollow shaft 36 to the dished pinion wheel 35 so that the valve spindle 2 may thereby be operated by hand.

It will be appreciated that, due to the arrangement of the upper and lower dog clutches 85, 56 and the clutch shaft 51, energisation of the motor automatically disconnects the drive from the hand wheel 63 and then connects the drive to the motor, whilst de-energisation of the motor automatically disconnects the drive from the motor and then connects the drive to the hand wheel 63.

In the alternative arrangement of a part of the actuating mechanism shown in Figure 3 of the drawings, a first or pinion wheel 91 keyed to a shaft 92 engages with an output gear wheel 93 similar to the dished gear wheel 24 shown in Figure 1. The shaft 92 is formed with upper and lower ends of reduced diameter which are positioned within upper and lower step bearings 96, 97 in the casing 1. The upper end 94 is axially positioned by means of an annular shoulder 98 against which abuts the pinion wheel 91 which in turn abuts against the upper step bearing 96. The lower step bearing is axially positioned by means of a washer 99 abutting an annular shoulder 100 and a wheel bearing 101 positioned intermediate the washer 99 and the lower step bearing 97. The hub 102 of a third or hand operated bevel wheel 103 is rotatably mounted upon the wheel bearing 101 and is formed with dogs 104. The hand operated bevel wheel 103 meshes with a bevel wheel 105 similar to the bevel wheel 61 shown in Figure 1. A two-way clutch 106 formed with lower dogs 107 is mounted on the shaft 92, splines 108 preventing rotation of the two-way clutch relative to the shaft. A spring 109 extends within an upper part of the two-way clutch 106 around the shaft 92 and abuts, at its lower end, a shoulder 110 on the two-way clutch 106 and, at its upper end, a collar 111 formed on the shaft 92. A wheel bearing 112 extends between the collar 111 and a thrust washer 113 and is restrained from upward movement by a circlip 114 secured to the shaft 92.

A clutch collar 115 is secured to the shaft by a pin 116 extending through the shaft 92 and through axial slots 117 in the two-way clutch 106. A ring bearing 118 supports a second or clutch pinion wheel 119 above the clutch collar 115, the clutch pinion wheel 119 being freely rotatably mounted on the two-way clutch 106. The hub of the

clutch pinion wheel 119 is provided with diametrically opposed lugs 71 similar to those described in connection with Figures 1 and 2, the lugs 71 supporting arms 72 provided with cylindrical weights 74 and roller cam followers 77 arranged to engage a surface 84 on the two-way clutch 106. The clutch pinion wheel 119 meshes with a clutch spur wheel 120 similar to the clutch spur wheel 66 shown in Figure 1 The upper end of the two-way clutch is formed with dogs 121. A fourth or motor spur wheel 122 provided with dogs 123 is freely rotatably mounted on the wheel bearing 111 and meshes with a motor pinion wheel 124 similar to the motor pinion wheel 90 shown in Figure 1.

The arrangement shown in Figure 3 operates in a similar manner to that described in conjunction with Figures 1 and 2. The spring 109 biasses the two-way clutch 106 in a downward direction so that the dogs 107 engage the dogs 104 an the hub 102 of the hand operated bevel wheel 103, and the drive is transmitted from the hand wheel 63 through the bevel wheel 105, the hand operated bevel wheel 103, the two-way clutch 106 and the shaft 92 to the pinion wheel 91. The pinion wheel 91 in turn drives the gear wheel 93 to actuate the valve spindle 2 in a manner similar to that described in conjunction with Figure 1.

Upon energisation of the electric motor, the clutch pinion wheel 119 is rotated, so that the cylindrical weights 74 are rotated and caused to move in an outward direction due to the centrifugal force, the roller cam followers 77 thereby being moved in an upward direction. Upward movement of the roller cam followers 77, against the action of the spring 109, moves the two-way clutch 106 upwardly and the dogs 107 out of engagement with the dogs 104 on the hub 102 and, upon further upward movement, moves the dogs 121 into engagement with the dogs 123 on the motor spur wheel 122, thereby connecting the electric motor through the motor spur wheel 122, the two-way clutch 106, the shaft 92 and the pinion wheel 91 to the gear wheel 93 to actuate the valve spindle 2. The dogs 121 are held in engagement with the dogs 123 on the motor spur wheel 122 by the continued rotation of the clutch pinion wheel 119. As described in connection with Figures 1 and 2, de-energisation of the electric motor automatically disconnects the shaft 92 from the motor and connects the shaft 92 with the hand wheel 63.

In the arrangement shown in Figures 4 and 5, a shaft 125 formed with upper and lower ends 126, 127 of reduced diameter is positioned with the upper and lower ends 126, 127 respectively in upper and lower step bearings 128, 129 in the casing 1. A weight carrier 130 is supported on a circlip 131 and is formed with a cylindrical hub 132 extending between the circlip 131 and a shaft bearing 133 which abuts a collar 134 formed upon the shaft 125. Axially fixed but freely rotatable upon the shaft bearing 133 is a bearing 135. A third or operated bevel wheel 136 and a hub 137, each provided with radial flanges 138, 139 fitting around the bearing 135, are freely rotatable thereupon. The hand operated bevel wheel 136 meshes with a bevel wheel 140 similar to the bevel wheel 61 shown in Figure 1. The hub 137 is formed with dogs 141 arranged to engage dogs 142 formed on a first or output pinion wheel 143 freely rotatable upon the shaft 125 and meshing with a dished gear wheel 144 similar to the dished gear wheel 124 shown in Figure 1.

The weight carrier 130 is provided with diametrically opposed lugs 145 each lug having a weight 146 pivotally mounted thereon by means of a pin 147. Each weight 146 is formed with an arm 148 provided with a stud 149 extending into axial slots 150 in a collar 151. Supported on the collar 151 is a thrust washer 152 and a top ring 153. Three rods 154, one of which is shown in Figures 4 and 5, extend through equiangularly spaced holes 155 in the top ring 153 and are secured to the top ring 153 by circlips 156. Each of the rods 154 extends freely through a hole in the bearings 135 and is screwed into a hub 157 to the output pinion wheel 143. Each rod 154 is provided with a spring 158 extending between the top ring 153 and the bearing 135 so that the top ring 153 and the clutch collar 151 together with the output pinion wheel 143 are biassed in a downward direction by the springs 158. The upper part of the output pinion wheel 143 is formed with dogs 159. A second or clutch pinion wheel 160 is keyed to the shaft 125 and meshes with a clutch spur wheel 161 similar to the clutch spur wheel 66 shown in Figure 1. A fourth or motor spur wheel 162 provided with dogs 163 is freely mounted on the hub of the clutch pinion wheel 160 and meshes with a motor pinion wheel 164 similar to the motor pinion wheel 90 shown in Figure 1.

In operation, the springs 158 bias the dogs 142 on the output pinion wheel into engagement with the dogs 141 on the hub 137 of the hand operated bevel wheel 136 so that the hand wheel 63 is operatively connected through the bevel wheel 140, the hand operated bevel wheel 136, the hub 137 and the output pinion wheel 143 to the dished gear wheel 144 which in turn actuates the valve spindle 2. Upon energisation of the electric motor the clutch pinion wheel 160 is rotated and rotates the shaft 125 together with the weight carrier 130. Upon rotation of the weight carrier 130, the weights

146 move in an outward direction due to the centrifugal force and the studs 149 move in an upward direction to move the collar 151 in an upward direction against the action of the springs 158. Upward movement of the clutch collar 151 is transmitted through the thrust washer 152, the top ring 153, the circlips 156 and the rods 154 to the output pinion wheel 143 to move the dogs 142 out of engagement with the dogs 141 on the hub 137 and, upon further upward movement of the clutch collar 151, to move the dogs 159 into engagement with the dogs 163 on the motor spur wheel 162, thereby operatively connecting the drive from the motor through the motor pinion wheel 164 and the motor spur wheel 162 to the output pinion wheel 143, the axial depth of the output pinion wheel 143 being such that upon upward movement the wheel still meshes with the dished gear wheel 144 to actuate the valve spindle 2. The dogs 159 on the output pinion wheel 143 are held in engagement with the dogs 163 by the continued rotation of the weight carrier 130. Upon de-energisation of the electric motor, the weight carrier 130 slows down and stops rotating and the springs 158 act to move the clutch collar 151, together with the output pinion wheel 143, downwardly to disengage the dogs 159 from the dogs 163 and, upon further downward movement to engage the dogs 142 with the dogs 141 on the hub 137. Thus upon de-energisation of the electric motor, the drive is automatically disconnected from the motor and then automatically connected with the hand wheel 63.

In the arrangement shown in Figures 6 and 7, the shaft 165 is positioned with its upper end 166 in a needle bearing 167 in the casing 1, and with its lower end 168 supported on a collar 169 resting on a hub 170 of a motor spur wheel 172 mounted on a bearing 172, secured to the casing 1, a ball bearing 173 radially positioning the end of the shaft. The motor operable spur wheel 171 is formed with dogs 174 and engages a motor pinion wheel 175 similar to the motor pinion wheel 90 shown in Figure 1. Freely rotatable on an upper part of the shaft 165 is a hand operated bevel wheel 176 formed with dogs 177 and engaging a bevel wheel 178 similar to the bevel wheel 61 shown in Figure 1. The hand operated bevel wheel 176 is axially located between a shoulder 179 formed on the shaft 165 and a circlip 180 extending around the shaft. A clutch sleeve 181 formed with axially extending arms or shoulders 182 is splined to the shaft 165. The shoulders 182 are formed with dogs 183. The lower end 184 of the clutch sleeve 181 is radially flanged and is provided with dogs 185. A spring 186 acts between the collar 169 and an annular shoulder 187 within the clutch sleeve 181 to bias the clutch sleeve in an upward direction. The output pinion wheel 188 is splined to the shaft 165, being axially secured by a pin 189, and engages a dished gear wheel 190 similar to the dished gear wheel 24 shown in Figure 1. The shoulders 182 of the clutch sleeve 181 extend through apertures 191 in the output pinion wheel 188. A clutch pinion wheel 192 is freely rotatable on the clutch sleeve 181, a wheel bearing 193 interposed between the clutch sleeve 181 and the clutch pinion wheel 192 having an upper end abutting the output pinion wheel 188 and is thereby restrained against upward movement. The clutch pinion wheel 192 engages a clutch spur wheel 192A similar to the clutch spur wheel 66 shown in Figure 1. The hub 194 of the clutch pinion wheel 192 extends axially and is formed with a dished flange 195 having radially and axially extending portions 196, 197. The dished flange 195 is provided with six weights 198 disposed at intervals around the flange, each being mounted upon a stud 199 having an outer portion 200 secured within the holes in the axially extending portion 197 of the dished flange 195 by grub screws 201, the inner portion 203 being formed with a screw thread 202 and screwed into the hub 194. The inner portion 203 of each stud 199 is of reduced diameter and fits within an inner portion 204 of a bore in the corresponding weight 198. The outer portion 200 of the stud 199 fits within an outer portion 206 of the bore in the weight 198. A spring 207 extends around the inner portion 203 between the end of the inner portion 204 of the bore and the outer portion 200 of the stud, thereby biassing the weight inwardly. Each weight 198 is formed with a frusto-conical face 208 arranged to abut an adjoining ball 209 positioned within a cylindrical hole 210 in the radially extending portion 196 of the dished flange 195. The balls 209 are supported upon a thrust plate 211 which rests on a flange 184 formed on a clutch sleeve 181. An annular bracket 212 secured to the dished flange 195 and abutting the motor spur wheel 171 restrains the hub 194 against downward axial movement.

In operation, the spring 186 biasses the dogs 183 into engagement with the dogs 177 on the hand operated bevel wheel 176, so that the drive is connected from the hand wheel 63 through the bevel wheel 178, the hand operated bevel wheel 176, the clutch sleeve 181, the shaft 165 and the output pinion wheel 188 to the dished gear wheel 190 which in turn actuates the valve spindle 2.

Upon energisation of the motor, the clutch pinion wheel 192 is rotated so that the weights 198 are rotated and move radially outwards against the action of the springs 207. The frusto-conical faces 208 on the

weights 198 bear upon the balls 209 to move them, together with the thrust plate 211 in a downward direction against the action of the spring 186. Downward movement of the thrust plate 211 is transmitted through the clutch sleeve 181 to move the dogs 183 out of engagement with the dogs 177 on the hand operated bevel wheel 176 and, upon further downward movement of the thrust plate 211 move the dogs 185 into engagement with the dogs 174 on the motor spur wheel 171. Thus the drive is connected from the electric motor through the motor pinion wheel 175, the motor spur wheel 171, the clutch sleeve 181, the shaft 165 and the output pinion wheel 188 to the dished gear wheel 190, which, in turn, actuates the valve spindle 2. Upon de-energising the electric motor, the clutch pinion wheel 192 slows down and stops rotating and the weights 198 move inwardly under the influence of the springs 207 thereby permitting the balls 209 together with the thrust plate 211 to move in an upward direction. Upward movement of the thrust plate 211 disengages the dogs 185 from the dogs 174 on the motor spur wheel 171 and, upon further upward movement of the thrust plate 211 engages the dogs 183 with the dogs 177 on the hand operated bevel wheel 176.

WHAT WE CLAIM IS :—

1. An actuator for an element such as a valve, operable alternatively manually or by a motor, wherein clutch means include a driving portion and a driven portion movable, by a centrifugal device arranged to be driven by the motor, from a position to which the portion is biassed and in which manually operable drive is connected through the clutch means with an output member driving the element to a position in which a motor operable drive is connected through the clutch means with the output member.

2. An actuator as claimed in Claim 1, wherein a first, driving, gear wheel is arranged to be connected through the movable portion of the clutch means, alternatively to a third, manually operable, driven, gear wheel or, when the second, motor operable, driven gear wheel is driven by the motor through the centrifugal device, to a fourth, motor operated, driven, gear wheel.

3. An actuator as claimed in Claim 2, wherein a rotatably mounted shaft carries the first gear wheel fixed thereto and the second, third and fourth gear wheels axially fixed but freely rotatable relative to the shaft.

4. An actuator as claimed in Claim 2, wherein a rotatably mounted shaft carries the first gear wheel axially movable and rotatable relative to the shaft, the second gear wheel fixed thereto and the third and fourth gear wheels axially fixed but rotatable relative to the shaft.

5. An actuator as claimed in Claim 3 or Claim 4, wherein the movable portion of the clutch means is axially movable upon the shaft and is formed with two clutch members, the first for making connection with the third gear wheel and the second for making connection with the fourth gear wheel and the centrifugal device includes radially inwardly biassed weights arranged, upon the centrifugal device being driven by the second gear wheel, to move outwardly and to move the movable portion of the clutch means against a biassing spring from a position in which the first clutch member is effective to a position in which the second clutch member is effective.

6. An actuator as claimed in Claim 3, wherein the shaft is hollow and a spindle is axially movable within the shaft and is conected by pins passing through axially extending slots in the shaft with two clutch members, the first for making connection with the third gear wheel and the second for making connection with the fourth gear wheel and the centrifugal device is arranged to move the spindle against a biassing spring contained in the shaft from a position in which the first clutch member is effective to a position in which the second clutch member is effective.

7. An actuator as claimed in Claim 4, wherein the movable portion of the clutch means is formed integral with the first, driving, gear wheel.

8. An actuator as claimed in any one of Claims 2 to 7, wherein the centrifugal device includes weight carrying levers pivotally mounted on the second gear wheel having arms arranged to co-act with the movable portion of the clutch means.

9. An actuator as claimed in Claim 8, wherein the arms are each provided with a roller adapted to engage a surface on the movable portion of the clutch means.

10. An actuator as claimed in any one of Claims 2 to 7, wherein the centrifugal device includes weights slidable on radially extending members arranged to be driven by the second gear wheel, the weights being arranged to co-act with the movable portion of the clutch means.

11. An actuator as claimed in Claim 10, wherein each of the weights is formed with a sloping face arranged to co-act with a member having a rolling surface adapted, upon outward movement of the weight, to move the movable portion of the clutch means against a biassing spring.

12. An actuator as claimed in Claim 10 or Claim 11, wherein each of the radially extending members is a cylindrical rod extending through a stepped bore in a corresponding weight, a spring extending around the rod within the bore between a shoulder formed on the rod and the stepped portion of the bore biassing the weight radially in-

wardly.

13. An actuator as claimed in any one of Claims 2 to 12, wherein interposed between the first gear wheel and an output gear wheel is an overload device including a pawl having a sloping face and a ball biassed into contact with the said face to transmit the drive, the biassing force being of a magnitude to permit disengagement of the ball and sloping face to disconnect the drive upon a predetermined value of torque attained by the drive.

14. An actuator as claimed in any one of Claims 2 to 13, wherein interposed between the first gear wheel and an output gear wheel is an overload device including a pawl or pawls each having a sloping face and a ball or balls each biassed into contact with the said face or respective faces to transmit the drive, the biassing force being such as to permit movement of the ball or balls over the sloping face or faces a distance proportional to the torque being transmitted, and switch means arranged to be operated by the ball or balls upon a predetermined value of torque being attained in the drive to interrupt the drive.

15. An actuator as claimed in any one of Claims 2 to 14, wherein the first and fourth gear wheels are elements of speed reduction gears.

16. An actuator as claimed in any one of Claims 2 to 15, wherein the second gear wheel is an element of a speed increasing gear.

17. An actuator arranged and adapted to operate substantially as hereinbefore described with reference to Figures 1 and 2, or with reference to Figure 1 as modified by Figure 3, or with reference to Figure 1 as modified by Figures 4 and 5, or with reference to Figure 1 as modified by Figures 6 and 7, of the accompanying drawings.

For the Applicants,
A. C. PRICE,
Chartered Patent Agent.

PROVISIONAL SPECIFICATION

Improvements in Actuators for Elements such as Valves

WE, JONES, TATE & CO. LIMITED, a British Company, of 165 Great Dover Street, London, S.E.1., do hereby declare this invention to be described in the following statement:—

This invention relates to actuators for members such as values an object being the provision of an improved form of actuator which may be operated by hand or by power as desired.

In an actuator for a member such as a valve operable alternatively manually or by a motor, according to the present invention by clutch means interposed between a manually operable driving part and a motor operable driving part and a driven part includes a portion movable, by a centrifugal device arranged to be driven by the motor, from a position in which the manually operably driving part is effective to a position in which the motor operable driving part is effective to drive the driven part.

In one embodiment of the invention a rotatably mounted shaft carries a first driven gear rotatable therewith a second motor operable driven gear wheel rotatable thereon and arranged to drive the centrifugal device, a third manually operable driving gear wheel rotatable thereon and a fourth motor operable driving gear wheel rotatable thereon and arranged when the clutch means are operated through rotation of the second gear wheel to be operatively connected by the clutch means to the driven gear wheel.

The shaft is hollow and a spindle is axially movable within the shaft and is connected by pins passing through axially extending slots in the shaft with two clutch members, the first for making connection with the third gear wheel and the second for making connection with the fourth gear wheel and the centrifugal device is arranged to move the spindle against a biasing spring contained in the shaft from a position in which the first clutch member is effective to a position in which the second clutch member is effective.

The first and fourth gear wheels are elements of speed reduction gears, whilst the second gear wheel is an element of a speed increasing gear and the gear wheels in mesh respectively with the second and fourth gear wheels are mounted on a common spindle arranged to be driven by an electric motor.

The third gear wheel is mounted upon and secured to a clutch part provided with teeth for engagement with the first clutch member and rotatable on a bearing bush provided on the hollow shaft. The third gear wheel is in the form of a bevel wheel in mesh with a complementary bevel wheel mounted upon a spindle rotatable by a hand wheel.

The fourth gear wheel is also rotatable upon a bearing bush upon the hollow shaft and the hub of the wheel is provided with teeth for engagement with the second clutch member.

The first and second clutch members and the first gear wheel are splined to the hollow shaft and a hub of the first gear wheel carries a bearing bush on which the second gear wheel is rotatably mounted. At one end the said bearing bush bears against a radially extending part of the first gear wheel and at the other end against a washer, the first gear wheel and the washer

being axially located upon the hollow shaft by means of circlips.

The pins connecting the spindle to the two clutch members fit through respective apertures near the opposite ends of the spindle and through apertures in the clutch members and are secured in position by circlips fitted to the pins at the outer sides of the clutch members. At its end remote from the third gear wheel the diameter of the spindle is reduced to provide a shoulder on which an end of a helical biasing spring is seated, the other end of the spring engaging a washer provided within the hollow shaft and located by means of an internal circlip.

The centrifugal device includes weight carrying levers rotatably mounted on the second gear wheel and having arms arranged to co-act with the clutch member. Thus the second gear wheel is provided on its face remote from the first gear wheel with diametrically opposite lugs carrying studs upon which the levers are rotatably mounted. The lever arms are curved and extend from the lever hubs in similar directions around the hollow shaft and carry at their ends respective rollers or cam followers adapted to engage the end surface provided by an annular flange on the part of the second clutch member remote from the fourth gear wheel. Parts of the lever hubs remote from the lever arms are formed with bosses to which respective weights are secured by means of screws, the arrangement being such that, when the biasing spring is effective in maintaining the engagement between the teeth of the first clutch member and the teeth of the clutch part carrying the third gear wheel, the weights are located at positions displaced in the direction of the axis of the hollow shaft in relation to the axis of rotation of the levers and close to the second clutch member. When, however, the second gear wheel is rotated, the weights tend to fly outwardly so that the rollers, by acting upon the second clutch member, move the spindle within the hollow shaft against the force of the biasing spring in order first to disengage the teeth of the first clutch member from the teeth of the clutch part carrying the third gear wheel and then to engage the teeth of the second clutch member with the teeth of the hub of the fourth gear wheel. By reason of determined clearance, it is impossible for first and second clutch members to be simultaneously engaged.

The first gear wheel is in mesh with a spur wheel keyed to a shaft carrying a pinion forming part of a further speed reduction stage and in mesh with a spur wheel keyed to an actuator output sleeve mounted on suitable ball thrust bearings and carrying internally an insert keyed to the output sleeve and internally threaded.

The various gears are accommodated within a suitable casing having a removable cover and carrying a terminal box and an indicator suitably driven to show the position of the valve or like member operated by the actuator.

Also driven through suitable speed reduction gearing are two limit switches adapted to terminate the operation of the electric driving motor at the terminal positions of the actuator output sleeve.

In operation, when the motor is inoperative and the hand wheel is turned, movement of the hand wheel is transmitted from the third gear wheel through the first clutch member to the first gear wheel, rotation of which effects rotation at a reduced speed of the output sleeve.

Upon energisation of the motor, the second gear wheel is rapidly accelerated so that the first few revolutions of the motor effect operation of the centrifugal device to effect coupling of the first gear wheel through the second clutch member to the fourth gear wheel, with the result that the motor drives the output sleeve.

Upon de-energisation of the electric motor, for example, by operation of a controller, torque switch or limit switch, the falling speed of the second gear wheel enables the biasing spring to overcome the centrifugal force exerted by the weights of the centrifugal device so that the spindle within the hollow shaft is moved to effect disconnection of the second clutch member from the fourth gear wheel and reconnection of the first clutch member to the clutch part carrying the third gear wheel so that the hand wheel is again operatively associated with the output sleeve. Turning of the hand wheel does not effect the electric motor since the second and fourth gear wheels are both loosely mounted on the hollow shaft.

For the Applicants,
A. C. PRICE,
Chartered Patent Agent.

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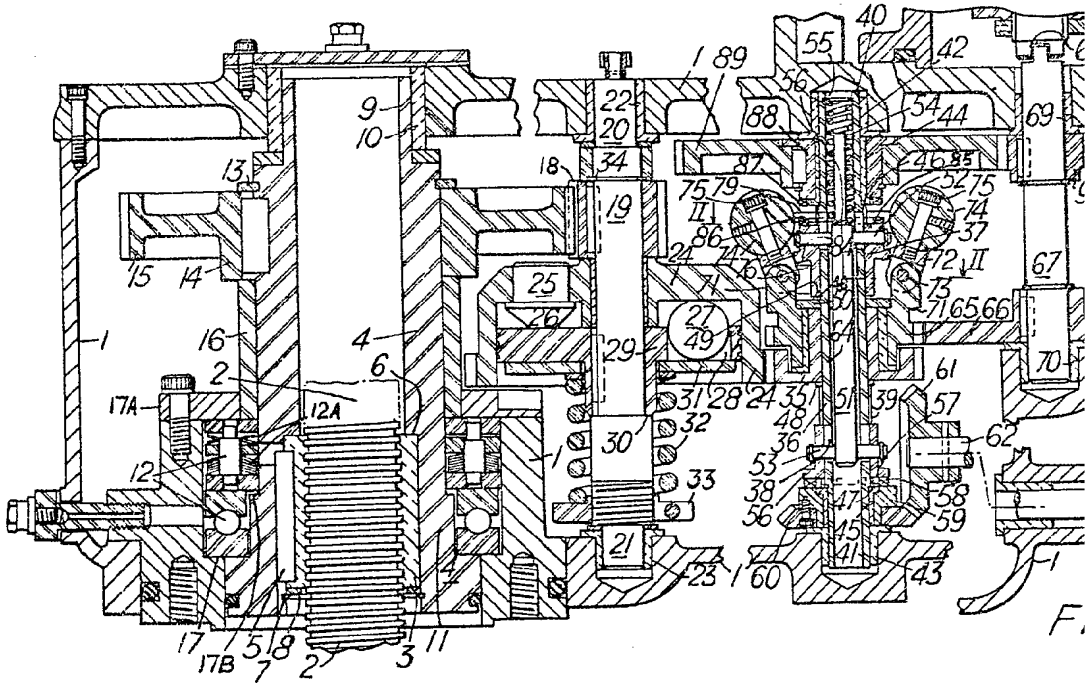
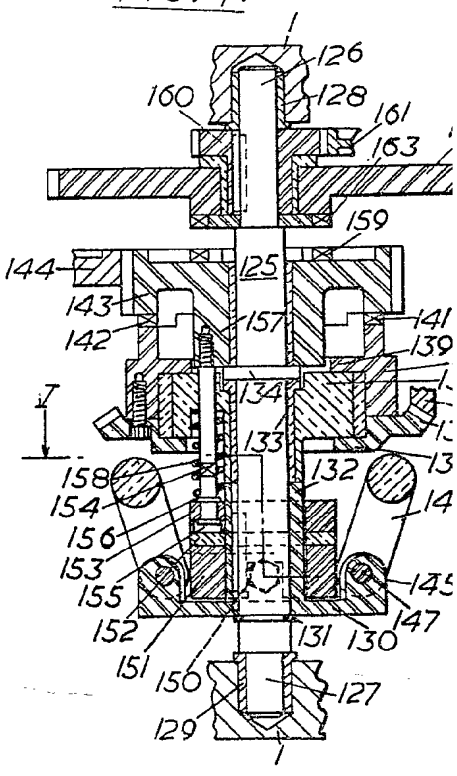


FIG. 4.



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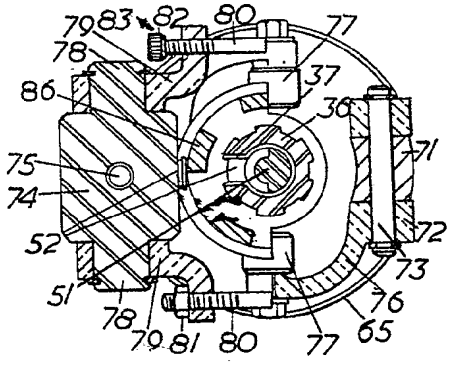

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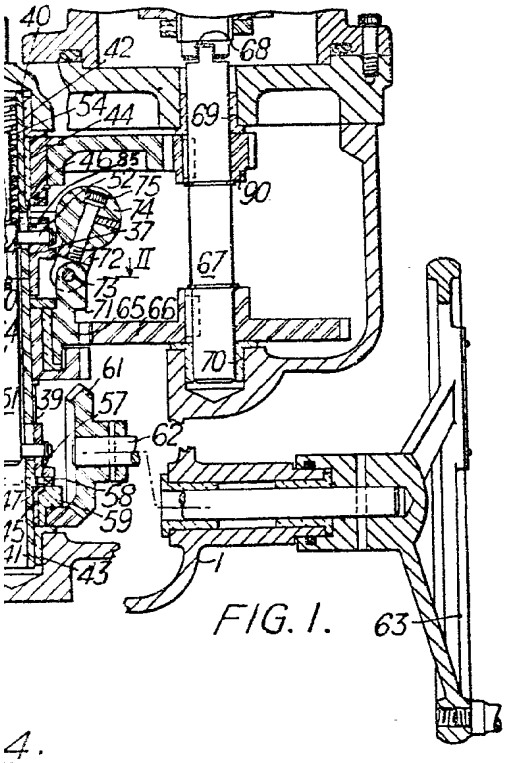

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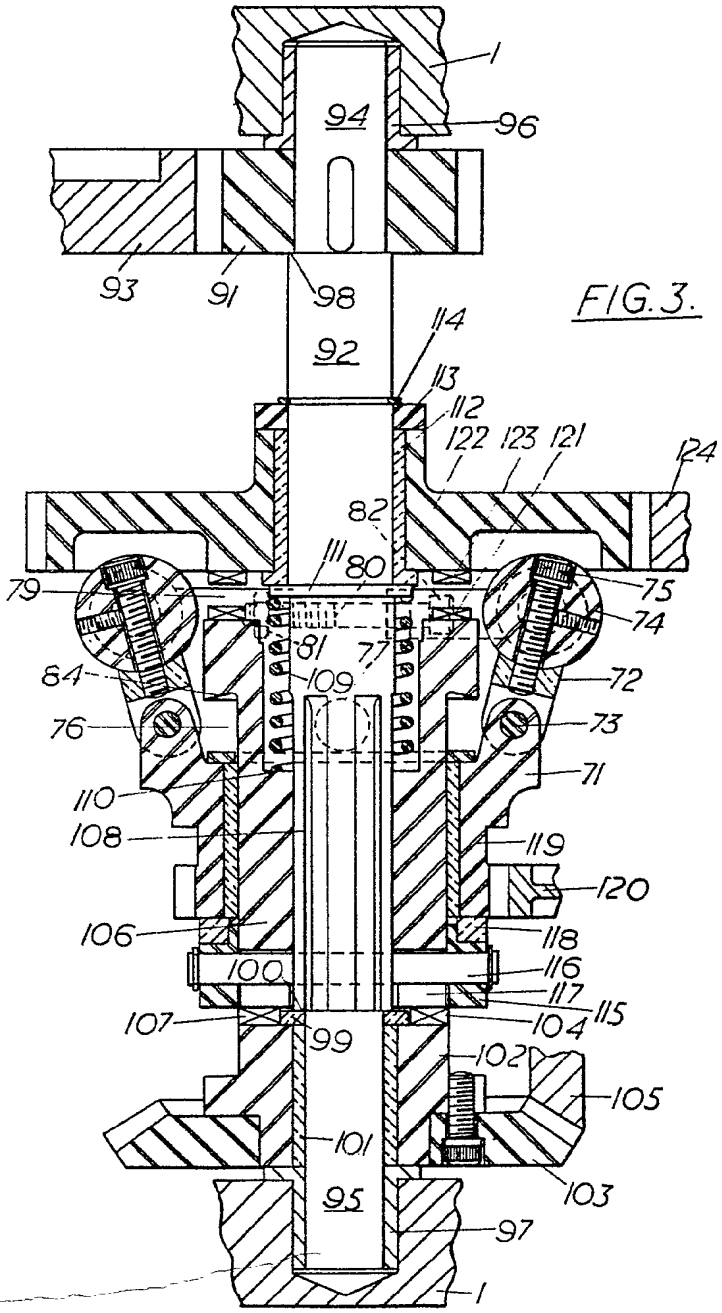

FIG. 3.

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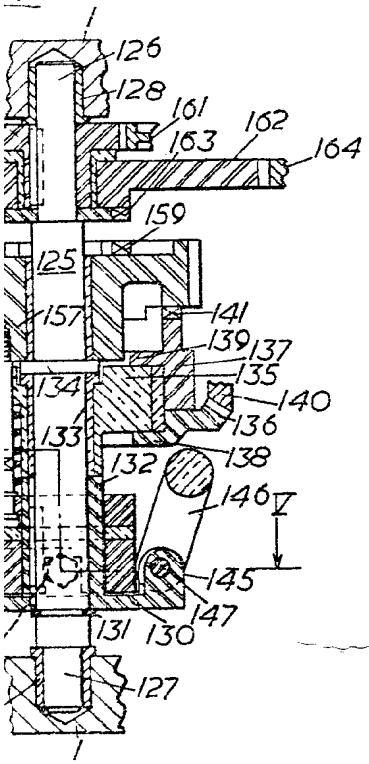

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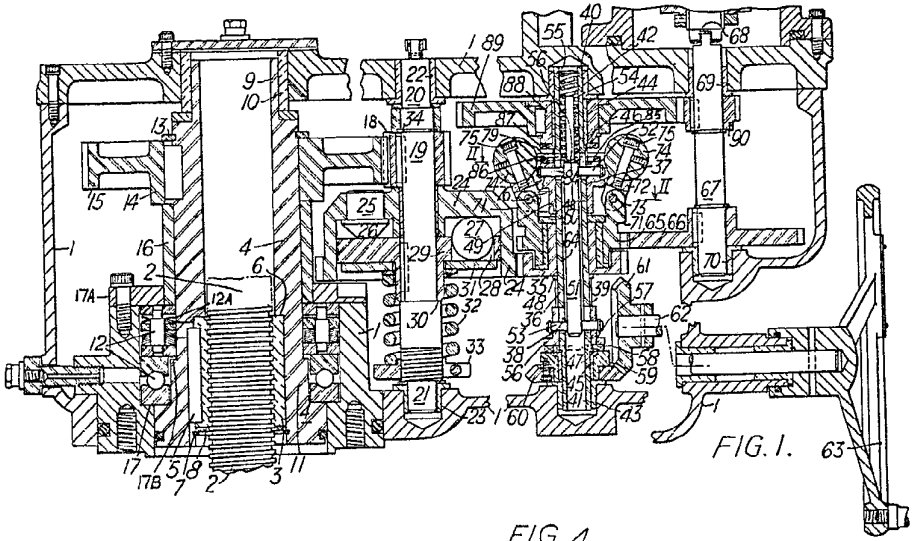

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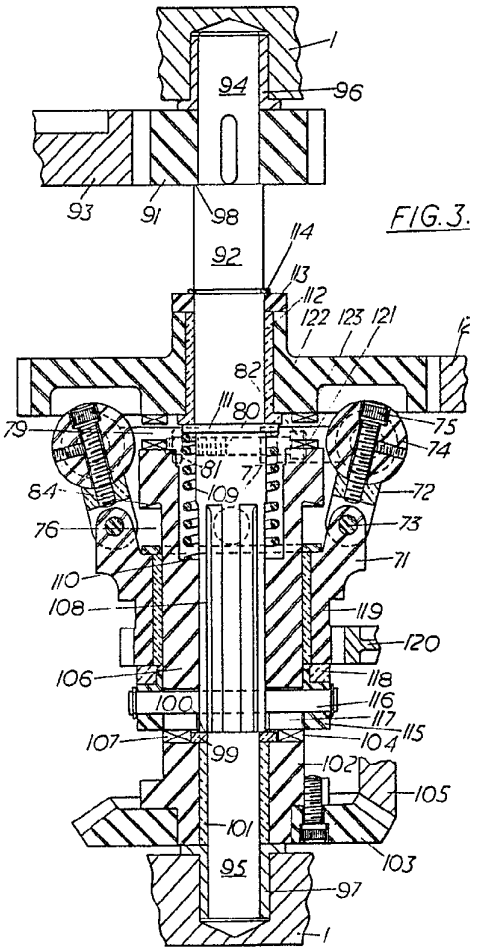
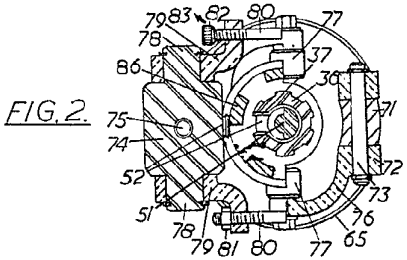


FIG. 3.



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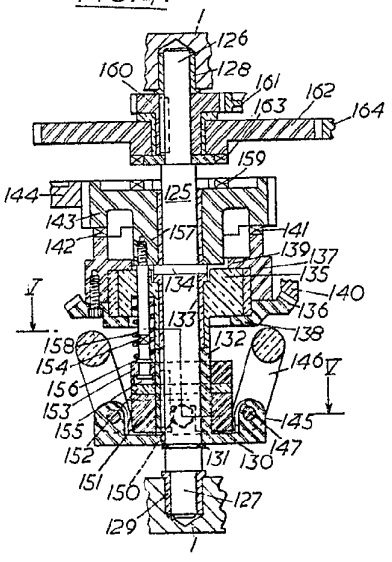

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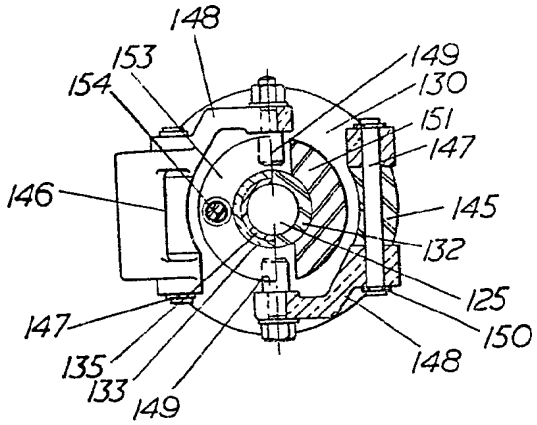
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FIG. 7.

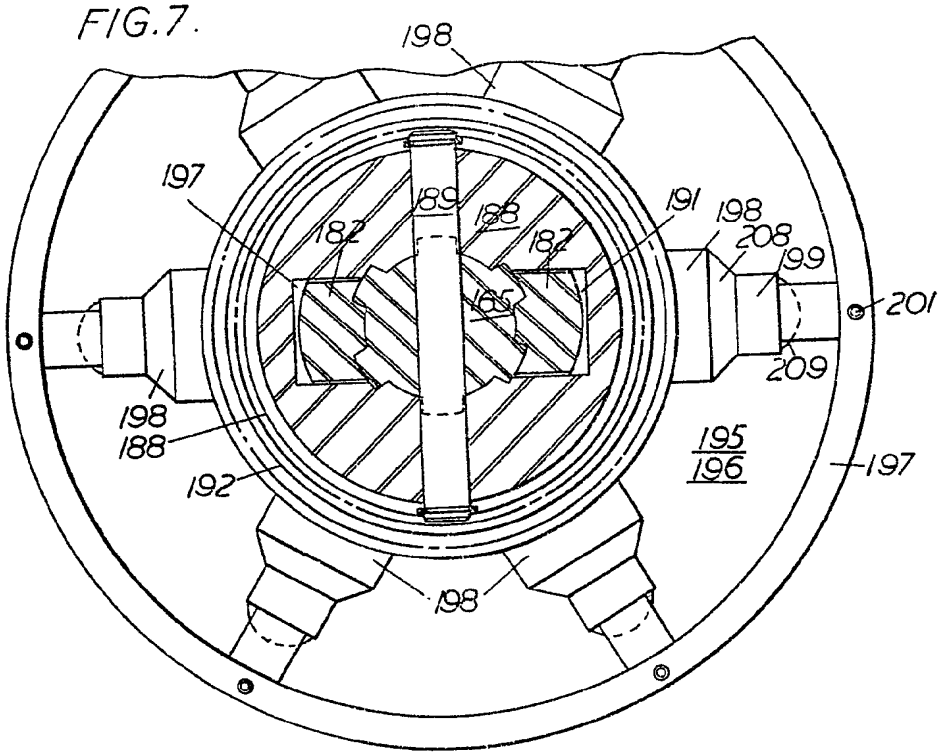
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FIG.6.

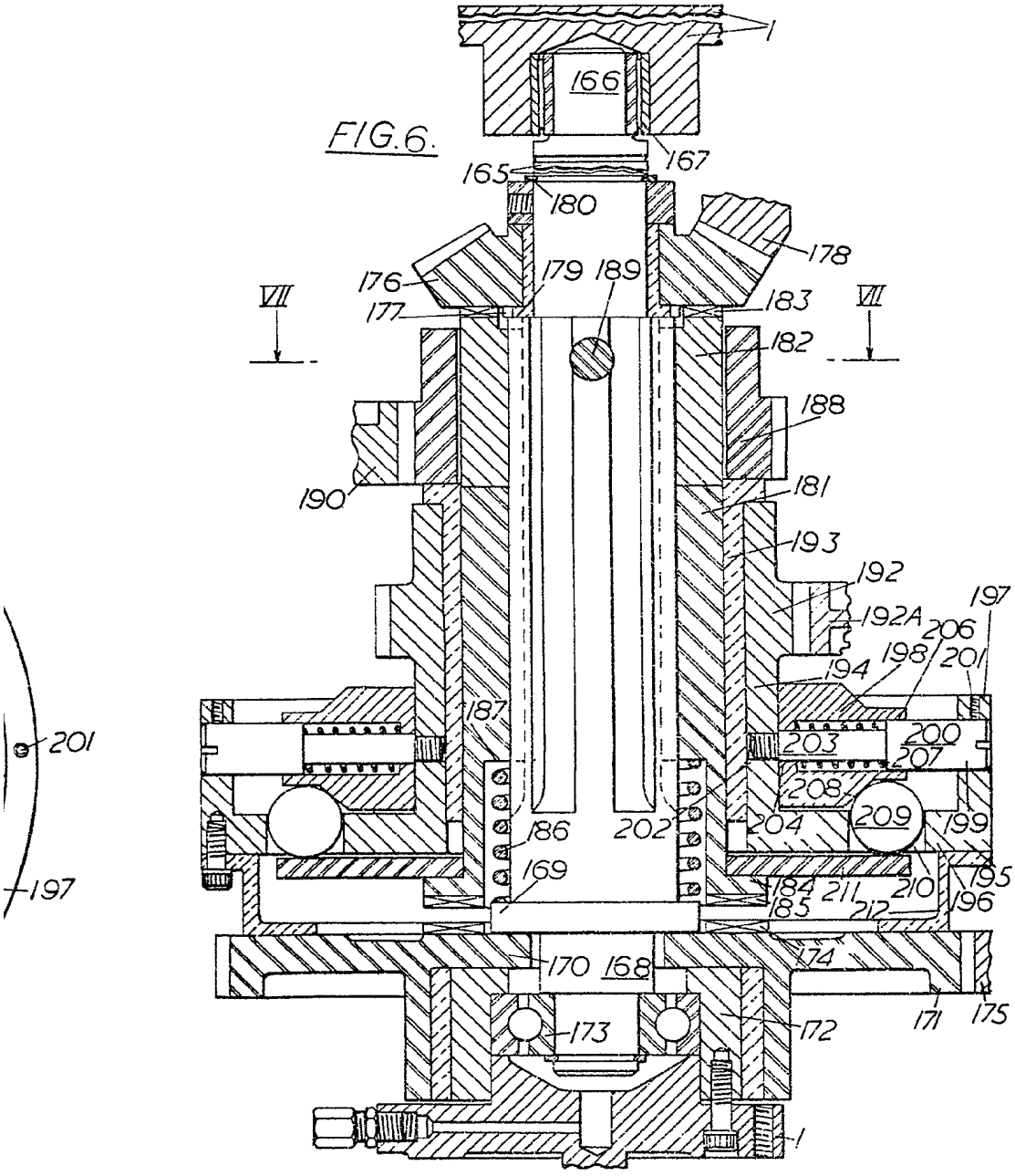

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FIG. 5.

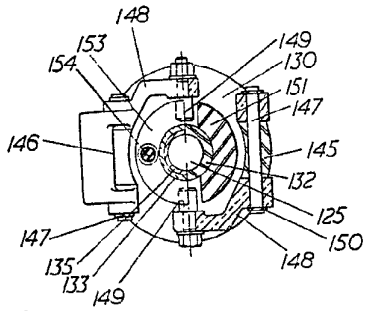

FIG. 7.

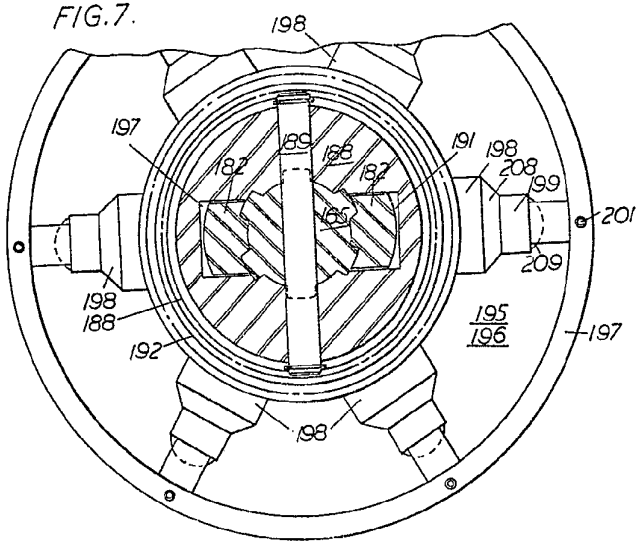

FIG. 6.